DEFINITION OF TERMS
MAGNETIC RESONANCE IMAGING

Antenna – device **used for transmitting or receiving radio waves**.

Artefact – spurious findings in or **distortion of an image**

Attenuation – **reduction in energy** or amount of beam of radiation when it passes through tissue or other substance.

Coil – **single or multiple loops of wire** (or another electrical conductor such as tubing) **designed to produce a magnetic field from current flowing through the wire** or to detect a changing magnetic field by voltage induced in the wire.

Contrast – **degree of difference between two substances** in some parameter, with the parameter varying depending on the technique used (e.g. attenuation in radiographic techniques or signal strength in MRI)

Cryogenic – relating to **extremely low temperature**

Diffusion – **spontaneous random motion of molecules in a medium**; a natural and continuous process.

Echo planar imaging – **fast pulse sequence** that can be **used to create MR images within a few seconds**.

Fat-suppressed images – images in which the **fat tissue** in the image **is made to be lower, darker signal intensity** than the surrounding structure.

Frequency – **number of times that a process repeats itself in a given period** (e.g. the frequency of radio waves is the number of complete waves per second)

Fringe field – **portion of the magnetic field** extending away from the confines of the magnet that **cannot be used for imaging** but **can affect nearby equipment or personnel**

Gating – **organizing data** so that the information use to construct the image comes from the same point in the cycle of repeating motion, such as a heart beat. The moving object is frozen at that phase of its motion, reducing image blurring.

Gauss (G) – **unit of magnetic filed strength** (*old unit*)

Gradient echo – **fast pulse sequence** that is **often used with 3D imaging to generate T2-weighted images**

Inversion recovery – **standard pulse sequence** available on most MRI imagers, usually used for T1-weighted images. The name indicates that the direction of longitudinal magnetization is reversing (inverted) before relaxation (recovery) occurs.

Magnetic Resonance (MR) – **process** by which certain **nuclei,** when placed in a magnetic field, **can absorb and release energy in the form of radio waves.** This technique can be used for chemical analysis or for the production of cross sectional images of body parts. Computer analysis of the radio-wave data is required.

Noise – random contributions to the total signal that **arise from stray external radio waves or imperfect electronic apparatus or other interference**. *Noise cannot be eliminated, but can be minimized*; it tends to degrade the images by interfering with accurate measurement of the true MRI signal, similar to the difficulty in maintaining a clear conversation in a noisy room.

Nuclear Magnetic Resonance (NMR) – **another name for magnetic resonance**; *this term is not commonly used.*

Prepared by: RC CARREON, RRT, MA Ed ©

Nucleus – **central portion of an atom**, composed of *protons and neutrons*

Paramagnetic – referring to **material that alter the magnetic field or nearby nuclei**. Paramagnetic substance are not themselves directly imaged by MRI but instead change of signal intensity of the tissues where they localize, acting as MRI contrast agents. Paramagnetic agents shorten the T1 and T2 of the tissues they affect, actions that tend to have opposing effects on signal intensity. In clinical practice, agent are administered in a concentration in which either T1 or T2 shortening predominates (usually the former) to provide high signal on T1 weighted images.

Perfusion – **flow of blood through the vessels** of an organ or anatomic structure: usually refers to blood flow in the small vessels (e.g. capillary perfusion).

Permanent magnet – object that **produces a magnetic field without requiring an external electricity supply**

Precession – **rotation of an object around the direction of force acting on that object**.

Proton density – **measure of proton** (i.e. hydrogen, because its nucleus is single proton) concentration (number of nuclei per given volume); **one of the major determinants of MRI signal strength in hydrogen imaging.**

Pulse sequence – **series of radio waves pulses designed to excite nuclei** in such a way that their energy release has varying contributions from proton density, T1 or T2 processes.

Radiofrequency (RF) pulse – **a short burst of radio waves**. If the radio waves are of appropriate frequency, they can give energy to nuclei that are within a magnetic field by the process of magnetic resonance. Length of the pulse determines amount of energy given to the nuclei.

Rapid Acquisition Recalled Echo – **commonly known as Fast or Turbo, Spine Echo**; a fast pulse sequence used to create spin echo – like T2 weighted images rapidly.

Raw data – **information obtained by radio reception of the MRI signals as stored by a computer**. Specific computer manipulation of these data is required to construct an image from them.

Relaxation – **return of excited nuclei to their normal, unexcited state** by the release of energy.

Relaxation time – **measure of rate at which nuclei, after stimulation, release their extra energy**

Resistive magnet – **simple electromagnet** in which e**lectricity passing through coils of wire produces a magnetic field**

Resonance – **process of energy absorption by an object** that is turned to absorb energy of a specific frequency only. All other frequencies would not affect the object (e.g. if one tuning forks is struck in a room full of tuning forks, only the forks tuned to that identical frequency would vibrate(resonate).

Signal – in MRI, **induction of current into a receiver coil by processing magnetization.**

Slice – **cross sectional image**; can also refer to the thin section of the body from which data are required to produce the image.

Spectroscopy – **science of analysing the components of an electromagnetic wave,** usually after its interaction with some substance (to obtain information about that substance).

Spin Echo – **standard MRI pulse sequence that can provide T1 weighted, T2 weighted or proton density weighted images.** The name indicates that a declining MRI signal is refocused to gain strength (similar to an echo) before it is recorded as raw data

Spin-Lattice relaxation – **release of energy by excited nuclei to their general environment**, *one of the major determinants of MRI signal strength*. T1 is a rate constant measuring spin-lattice relaxation.

Spin-Spin relaxation – release of **energy by excited nuclei as a result of interaction among themselves**; *one of the major determinants of MRI signal strength*. T2 is a rate constant measuring spin-spin relaxation.

Superconductive magnet – **material that has a greater effect with a magnetic field**; it can dramatically decrease T2 of tissues, causing a total loss of signal by the absorbing structure.

T1 – rate constant measuring spin-lattice relaxation

T2 – rate constant measuring spin-spin relaxation

Tesla (T) – **unit of magnetic field strength**; (*SI unit*) **1 tesla equals 10,000 gauss** or *10 kilogauss* (other unit f magnetic field strength). The earth's magnetic field approximates 0.5 gauss.

Transverse plane – plane that extends across the axis of the body from side to side, **diving the body part into upper and lower portions.**

HISTORICAL DEVELOPMENT

1940's – **Bloch and Purcell** first discovered the **properties of magnetic resonance**.

1952 – **Bloch and Purcell** awarded the **Nobel Prize in Physics**. (Spectroscopy)

1973 – **Lauterbur** published the **first cross sectional images objects obtained with MRI technique**.